COMMUNICATION

Innovate for Impact: Young Adults Education and Empowerment for Climate Action

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Abstract

Anthropogenic climate change is a significant driver of disasters, such as tropical storms, floods, drought and loss of biodiversity, amplifying their frequency and severity worldwide. The annual incidence of extreme weather-related events increases with growing human exposure to risks. The Sendai Framework and its associated Sustainable Development Goals (SDGs) recognise the interlinkages between disaster risk reduction, climate change adaptation and sustainable development. However, despite the best intentions of disaster planners, the current efforts are suboptimal in promoting implementation. Education is a critical goal to achieve sustainable development. Environmental Education for Sustainable Development (ESD) seeks to equip students with the knowledge, skills, values and agency necessary to address the complex challenges of climate change and global warming. One example of such an educational programme is the "Speak to Me in Numbers" programme. This interdisciplinary ESD programme educates 9th graders in SDG-related scientific content through scientific data analysis. It strives to inspire students to develop their agency and become responsible future citizens by taking local climate action to bring about sustainable development in their communities. Empowered young people who become agents that bring about global changes are crucial in the context of the climate crisis. However, such efforts should be undertaken cautiously to avoid doing more harm than good by evoking climate anxiety. These implications are discussed.

Keywords: Climate change; Disaster risk reduction; Education for Sustainable Development (ESD); Sustainable Development Goals (SDGs); Youth empowerment

Climate change and its impact on disaster trends

Anthropogenic climate change has become a significant driver of disasters, amplifying their frequency and severity worldwide. Warming the Earth's atmosphere due to excessive greenhouse gas emissions has led to a cascade of adverse effects on our planet's natural cycles and systems. Rising global temperatures contribute to the intensification of weather events, such as extreme storms, floods, heat waves, droughts and wildfires. These events, in turn, result in devastating consequences for both human and natural systems (Mechler & Bouwer, 2015; Van Aalst, 2006).

Between 2002 and 2021, an average of 370 disasters of natural causes were documented by the International Disaster Database (EM-DAT), leading to an average annual death toll of 60,955 people globally. These disasters affect an average of 198.9 million people yearly, primarily (91%) by weather-related events, such as drought, floods and storms. Moreover, they cause an annual average loss of US$ 187.7 billion (CRED, 2023). In 2022, heatwaves alone claimed over 16,000 human lives in Europe, whereas droughts affected a staggering 88.9 million people in Africa.

Singlehandedly, Hurricane Ian caused catastrophic damage amounting to US\$ 100 billion in the Americas. These figures underscore the immense toll that disasters of natural causes, exacerbated by climate change, have on human lives and economies worldwide (CRED, 2023).

Recent studies suggest that the yearly incidence of extreme weather-related events increases, causing a growing human exposure to these risks (Keim, 2020). Significant heatwaves and floods are noted, coupled with increased deaths associated with these disaster types (CRED, 2023; Franzke & Torelló i Sentelles, 2020). These trends suggest that the climate change crisis is expected to worsen and pose an even graver challenge to humankind and nature in the near future (Tong *et al.*, 2022). Moreover, anthropogenic climate change causes wide-scale destruction of the environment through degradation, defaunation and fragmentation of ecosystems and their components, leading to biodiversity losses and disruption of nature on a wide scale (Malhi *et al.*, 2020).

The Sendai Framework and Sustainable Development Goals (SDGs)

The Sendai Framework 2030 is a global initiative that focuses on disaster risk reduction in the context of climate change. Its primary purpose is to ensure the resilience of communities and nations in the face of increasing natural hazards and their impacts. This framework recognises that climate change exacerbates the frequency and intensity of disasters, posing significant challenges to sustainable development. The Sendai Framework aims to create a safer and more resilient future by integrating disaster risk reduction into development policies and practices. (Aitsi-Selmi, Egawa, Sasaki, Wannous & Murray 2015; Kelman, 2015; UNDRR, 2023)

The goals of the Sendai Framework 2030 are centred around seven global targets to be achieved over the next decade. These targets focus on reducing mortality, the number of affected people, economic losses, damage to critical infrastructure and disruptions to essential services. The framework also aims to enhance international cooperation, strengthen disaster risk governance and improve the availability and accessibility of disaster risk information. By pursuing these goals, those involved with the Sendai Framework strive to build resilient communities and nations that can withstand the impacts of climate change-related disasters and achieve sustainable development in the face of adversity (Aitsi-Selmi *et al.*, 2015; Kelman, 2015; UNDRR, 2023).

The Sendai Framework 2030 aligns with the Sustainable Development Goals (SDGs) adopted by the members of the United Nations. Although not infallible, the SDGs aim to secure a prosperous future for upcoming generations, with a primary focus on eliminating poverty, preserving the planet and ensuring inclusivity. They encompass a wide range of societal requirements, including education, health care, social security and employment prospects, as well as tackling global warming and safeguarding the environment. By addressing these pressing issues, the aim of these goals is to create a world that is sustainable, equitable and conducive to a better quality of life for all (UNDESA, 2023b).

The Sendai Framework and the SDGs recognise the interlinkages between disaster risk reduction, climate change adaptation and sustainable development. By integrating these goals, the framework seeks to promote sustainable development practices that reduce vulnerabilities and enhance resilience. This includes eradicating poverty, promoting inclusive and sustainable economic growth, ensuring access to quality education and health care and fostering resilient infrastructure and sustainable cities (UNDESA, 2023b; UNDRR, 2023) .

However, several studies suggest that despite the best intentions, the current efforts are suboptimal in promoting sufficient SDG implementation (Leal Filho *et al.*, 2020; Moyer & Hedden, 2020; Zhao *et al.*, 2022). Projections even estimate that by 2030, one in every four young people will reside in one of the 28 most vulnerable countries for climate change-related risks, none of which is expected to achieve any of the SDG targets (Moyer & Hedden, 2020).

Challenges in promoting sustainable development

For over two decades, arguments voiced in the media and scientific outlets claim that human psychology is not designed to solve the global climate change crisis. Humans are said to dismiss events that are remote in time and space, as well as resort to denial, exert excessive optimism or resort to excessive faith (e.g. fatalism) or technological fixes that someone else will figure out (Atkinson & Jacquet, 2022).

We suggest an option whereby a complex psychosocial framework should be considered. When dealing with the adversities of climate change-related emergencies and disasters, specifically death and injury, one should consider that rationality, realism, reasonable decision-making and voluntary, conscious control are negatively affected (Akil, Robert-Demontrond & Bouillé 2018; Wolfe & Tubi, 2019). In other words, there is not simply an information deficit that could be overcome by raising awareness, but rather an emotional response pushing back on such an attempt to raise awareness (Suldovsky, 2017; Wolfe & Tubi, 2019). Consequently, mainstream approaches to promoting behavioural change are inapt in motivating and maintaining a sustainable change in human behaviour (Abunyewah et al., 2018; Becker et al., 2013; Levac et al., 2012; Lim, 2022; Olympia et al., 2010; Paton, 2019).

Most attempts at engaging the public in climate change risk reduction behaviour follow similar paths, predominantly through risk communication. This approach follows the information deficit model (Abunyewah et al., 2020; Suldovsky, 2017), which assumes that the public lacks sufficient information and that increasing awareness of risks and elevating threat perception can generate the motivation needed for preparedness behaviour (Glik, 2007; Paton, 2019). Although true in some cases, raising awareness is usually insufficient in changing behaviour in such contexts, even if behavioural intent exists (Maidl & Buchecker, 2015).

Moreover, many risk communication efforts use fear tactics as the primary approach to foster behavioural change, despite the evidence suggesting that this approach does more harm than good (Ruiter et al., 2014) and may even lead to climate anxiety, that is, psychological response characterised by feelings of worry, fear, distress and sometimes frustration, guilt and grief about the current and future impacts of climate change (Hickman et al., 2021; Verlie, 2019). Arguably, this phenomenon can be linked to fear of death, which may become apparent in one's consciousness once triggered by a discussion of the gloomy prospects of climate change, as proposed by Terror Management Theory (Pyszczynski et al., 2015; Wolfe & Tubi, 2019). In fact, Wolfe and Tubi argue that mortality awareness may be the missing link in climate response studies. The authors claim that exposure to stimuli that highlight climate change's potentially life-threatening effects may exacerbate counter-productive behaviours (Smith et al., 2022; Stollberg & Jonas, 2021; Wolfe & Tubi, 2019). For example, Akil et al. suggest that anxiogenic risk communication can lead to more pro-materialistic, instead of pro-environmental consumer choices (Akil et al., 2018).

Climate change risk communication and education can effectively bring about sustainable behavioural change; however, this requires innovative socio-ecological approaches to engage populations in anticipatory and preventive action (Odiyo & Volenzo, 2019). Recent studies show that such alternative approaches that do not involve fear tactics, in particular concerning climate change, are available. These approaches include the use of optimism and positively framed emotional messages (Peters et al. 2022), empowerment of individuals and communities to assume a more substantial role in shaping their fate and future (Börner, 2023; Brooks et al., 2017; Casas et al., 2021; Lejano et al., 2022) and re-shaping behaviour through socio-normative messaging (Lim et al., 2022; Lim, 2022; Peters et al., 2022).

Environmental education and education for sustainable development

Education is a critical tool in achieving sustainable development (Piao & Managi, 2023). Taking its shape in the 1970s, Environmental Education focuses on the natural environment, environmental

problems and conservation (Reis & Roth, 2007). It is designed to provide effective development of deep environmental awareness and practical tools to address specific environmental issues (Gough, 2013). Similarly, climate (change) education is the teaching of the science, impacts and solutions related to climate change, which provides learners with a critical awareness of global environmental challenges caused by climate change and their impact on all components of the environment. Environmental and climate education are teaching efforts that promote public awareness, knowledge and understanding of the environment, its functions and the human impact. These were coined by Roth in 1992 as "environmental literacy," that is, the ability to effectively diagnose the state of the environment and apply appropriate measures to preserve it (Roth, 1992). It also aims to foster positive attitudes, values and motivation to protect and improve the environment for the benefit of human and non-human species (Monroe *et al.*, 2008).

Education for Sustainable Development (ESD) is a more holistic, system-level approach that examines the interconnections between environmental, social and economic aspects of sustainability. Its breadth can sometimes be considered a disadvantage, as it may dilute the emphasis on environmental protection. It can further be criticised for not employing enough 'more-than-human' kin in teaching environmental issues, as these programmes tend to focus more on human-related sustainability issues. Nevertheless, applied appropriately, ESD can be an approach to infuse sustainability and environmental literacy into established environmental education in a way that seeks to equip students with the requisite knowledge, skills and values to address the complex challenges of our time, namely, climate change. It aims to foster a deep understanding of sustainability principles, environmental stewardship, social equity and economic viability (Perwitasari *et al.*, 2023). ESD allows students to make informed decisions and act in a way that conserves the environment while maintaining economic benefit for all and a just society for current and future generations (Blonder & Rosenfeld, 2019; Ferguson *et al.*, 2022).

ESD is particularly crucial for educating students as future scientists and responsible citizens (Holfelder, 2019; Taimur & Sattar, 2020). Moreover, ESD is vital for fostering collaboration (Laurie, Nonoyama-Tarumi, Mckeown & Hopkins 2016). Sustainability challenges require collective efforts and interdisciplinary approaches. ESD encourages students to collaborate with their peers, promoting teamwork and cooperation. By working together, students can pool their knowledge and perspectives, leading to innovative solutions that consider sustainability's social, economic and environmental dimensions (Laurie *et al.*, 2016; Taimur & Sattar, 2020). Through group projects, discussions and experiential learning activities, students develop communication and interpersonal skills essential for effective collaboration in the real world (Agbedahin, 2019; Kioupi & Voulvoulis, 2019; Laurie *et al.*, 2016).

ESD goes beyond traditional academic subjects and encourages students to become active participants in shaping a more sustainable future. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), it helps them recognise the consequences of individual and collective actions on the planet and society. Furthermore, students can develop empathy, cultural sensitivity and a sense of responsibility by learning about global challenges such as poverty, inequality and environmental degradation (UNESCO, 2015). They become equipped to make informed choices and take action to create a more sustainable and equitable world. Moreover, students are empowered to become change agents and contribute to developing sustainable technologies and practices (Agbedahin, 2019; Kioupi & Voulvoulis, 2019; Laurie *et al.*, 2016)

Taken together, there are several key elements that emerge as critical when designing an ESD programme. These include a holistic approach that integrates the environmental, social and economic dimensions of sustainability without compromising the environmental literacy gains. In addition, an effective ESD programme should offer a collaborative learning experience and active participation in order to foster agency and empower students to take local action and bring about sustainable change.

The "Speak to Me in Numbers" programme as an example of ESD

One example of such an educational programme is the "Speak to Me in Numbers" programme developed by the Department of Science Teaching of the Weizmann Institute, Rehovot, Israel. Unlike some other ESD programmes that may not focus enough on data literacy (Letouzé, 2016), this programme addresses global issues based on a dialogue between mathematical and science-based data. In this way, it introduces 9th graders to some of the SDGs that the world faces.

"Speak to Me in Numbers" is an interdisciplinary ESD programme that teaches SDG-related scientific content through an evidence-based approach to data analysis (Rap *et al.*, 2022). Each module focuses on a different SDG challenge, presenting students with related authentic data (in various mathematical representations) and scientific backgrounds. The SDGs chosen for the different units were carefully selected to align well with a ninth-grade curriculum. The programme's curriculum was structured to emphasise objectives that are most relevant to the students' lives and can be effectively woven into the science syllabus, such as those related to the carbon cycle, acid-base solutions and alternative energy sources. For example, the programme includes modules about SDG3, dealing with good health and well-being, SDG6 dealing with clean water and sanitation, SDG7 dealing with affordable and clean energy, SDG13 dealing with climate action and SDG14 dealing with life below water (UNDESA, 2023a).

The units in the "Speak to Me in Numbers" curriculum are based on several design features, including data-based challenges requiring mathematical literacy to address them and students' construction of evidence-based scientific arguments. After an introduction to the relevant SDG, students are presented with relevant graphs, charts and data tables that relate to a specific issue or challenge. Students are then tasked with performing mathematical computations of the data, reaching data-based conclusions and articulating their data-driven arguments. At the conclusion of every unit, students are presented with an opportunity to plan and execute an activism activity. This activity is designed to be data-driven, urging students to formulate an action plan based on the data available to address a certain SDG challenge. Typically, these activities are situated within the students' local environment, fostering an authentic sense of relevance and connection. They encourage students to address specific sustainability issues while improving their scientific and mathematical abilities. They learn to articulate their ideas effectively, construct compelling scientific arguments, cultivate an awareness of the need for change in their immediate surroundings and become agents of change in their local environment (Rap *et al.*, 2022).

For example, the unit discussing SDG14 ("Life below Water") relates to the negative consequences of human activities on the Earth's oceans. At the start of the unit, students are asked if they perceive this issue to be of any concern to them, given that most of them do not reside near the ocean. Students are then presented with data concerning carbon dioxide emissions, ocean acidification and its effect on marine life, the concept of overfishing, the Great Pacific Garbage Patch (i.e. a collection of plastic debris in the Pacific Ocean) and macro and micro-plastics and their impact on marine life and food chains. Students are asked to contemplate the consequences of micro-plastics in the oceans and how that phenomenon relates to them. Lastly, students are engaged in activism efforts pertaining to plastic packaging and propose recommendations on how to change packaging to reduce the amount of plastic used. (Rap *et al.*, 2022)

Similar curricula and pedagogical programmes to the "Speak to Me in Numbers" programme were developed to equip and empower future citizens to address and tackle global challenges, all while utilising cognitive skills and scientific knowledge (Rap *et al.*, 2023). Such initiatives are promising to unleash the potential of ESD to promote sustainable change in people's lives.

Nevertheless, the development of such pedagogies should be mindful of the adverse consequences of students' exposure to unsettling content. Prior studies have shown that climate change teaching to students can unleash overwhelming emotions of frustration, grief and guilt among students (Verlie, 2019). Therefore, emphasis was placed on ensuring that the "Speak to Me in Numbers" programme supports students' engagement in climate change action without

triggering such climate anxiety. For example, some of the topics addressed in the programme were very relevant to the students' daily lives, including the issues of wearing masks during the COVID-19 pandemic, as well as the rising sea levels. In these topics, we carefully considered how to phrase the wording of the questions so as not to instil fear among students living in coastal areas who might be anxious about their homes' fate or students who are anxious about contracting the virus. For instance, concerning the rise of sea levels, an emphasis was made concerning the time frames for sea level rise, that is, not immediate. For the pandemic content, reduction of content-related anxiety was achieved via an emphasis on the efficacy of individual behaviour (e.g. mask-wearing, personal hygiene, physical distancing) in reducing the risk of illness, as well as a focus on treating information with caution given the multitude of misinformation. In addition, instead of focusing on the looming aspects of failed action, the programme encourages students' activism, calling for achievable local changes that will accumulate into global changes by harnessing more people to join such initiatives. Moreover, the programme is taught by teachers who undertook a professional development that ensured not only their capacity to effectively utilise the programme's contents, but also to address any concerns raised by the students regarding the programme's curriculum.

Young people empowerment and activism

Traditionally, young people have primarily been depicted in a limited manner as a group highly vulnerable to adverse effects during disasters. However, there is now a growing acknowledgement of the potential of young people as change agents in their communities and as active participants in shaping disaster risk reduction policies and practices (Cox *et al.*, 2017). One example is the *School Strike for Climate* movement, which is a global movement led by young people to put moral pressure on policymakers and limit global warming (Verlie & Flynn, 2022).

Empowering young people to take local action that can bring about global change is crucial in the context of climate change (Ralls *et al.*, 2022). Young people have a significant stake in the future and are often at the forefront of raising awareness about environmental issues. By providing them with the knowledge, tools and opportunities to take action at the local level, their creativity, passion and potential to create meaningful change on a global scale can be sparked (Bandura & Cherry, 2020; Bentz & O'Brien, 2019).

This notion is supported by previous work looking into young people empowerment in the context of disaster risk reduction (Pfefferbaum *et al.*, 2018). For example, Haynes and Tanner demonstrated the benefits of participatory videos led by young people in the Philippines in raising awareness of climate change-related disaster risk and advocating for the need for disaster risk reduction in their communities (Haynes & Tanner, 2015). Similarly, Cox *et al.* reported that Canadian young people are both ready and capable of playing an integral role in climate change-related disaster risk reduction (Cox *et al.*, 2019). Similar findings were reported by Vogel *et al.* (2022) for South African students (Vogel *et al.*, 2022). Moreover, educational initiatives that empower young people were also beneficial in other contexts, such as earthquake preparedness (Bodas *et al.*, 2019).

The "Speak to Me in Numbers" programme strives to do exactly that – empower young people to take action to bring about local changes in their communities. As part of the programme, students were asked to consider how changes in their behaviour could impact the environment. For example, students thought about their carbon footprint and how more mindful usage in various areas (such as transportation, electricity and nutrition) could reduce their carbon footprint and have a longer-term positive impact on the environment. Sometimes this activity resulted in an increased sense of agency among students and even led to actual agency, as opposed to only sense of agency, through the creation of more extensive activism. In this regard, student agency relates to the "development of an identity and a sense of belonging. When students develop agency, they rely on motivation, hope, self-efficacy and a growth mindset (the understanding that abilities and
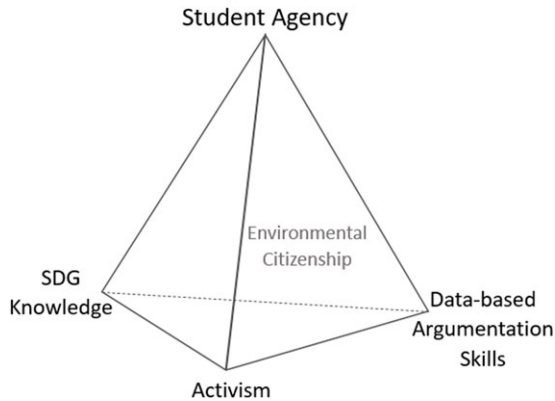
Figure 1. A schematic representation of the interlinks between Sustainable Development Goals (SDGs) knowledge, data-based argumentation skills and students' activism (based on Rap *et al.*, 2022).

intelligence can be developed) to navigate towards well-being" (OECD, 2019). Moreover, student agency refers to the quality of students' self-reflective and intentional action and interaction with their environment. It encompasses variable notions of agentic possibility ("power") and agentic orientation ("will") (Klemenčič, 2015). According to Klemenčič, studentship is highly conducive to engagement. In other words, students are likely to become change agents, as they seek to exert some influence on their lives and surroundings. Moreover, student agency can translate into behavioural change (Klemenčič, 2015).

The programme fosters students' agency to perform the task of becoming a change agent. For example, various groups of students decided to engage in activism at both the school and community levels. For instance, students taught their peers at school about the climate change challenges and ways to address them while using data they had acquired in our programme. In this way, they persuaded other students to act and contribute to the local changes. Examples of such activities included replacing school light bulbs with more energy-efficient ones, advocating for the upgrading of air conditioning units at the school to consume less electricity, reducing the use of plastic bottles and transitioning to reusable ones, changing transportation habits to school and more. The development of students' agency through activism practice is supported by other research (Littrell *et al.*, 2020).

Rap *et al.* (2022) proposed a model according to which there is a mutual and dynamic relationship between developing SDG knowledge, developing data-based argumentation skills and fostering students' activism. See Figure 1. These processes form an interconnected triangle within the model, with each element mutually benefiting and reinforcing the others. Moreover, each process plays a role in nurturing student agency regarding sustainability matters (located at the apex of the model's outer triangle) (Rap *et al.*, 2022). Combined, these elements support the formation and development of environmental citizenship, that is, the responsible pro-environmental behaviour of citizens who act and participate in society as agents of change, both individually and collectively, at the local, national and global levels (Hadjichambis & Reis, 2020). Within the "Speak to Me in Numbers" programme, for example, these interconnected facets are demonstrated through the linkage between the data students are presented with concerning certain SDGs, the assignment they perform in developing scientific and mathematical arguments surrounding these data and the support of agency development to follow through with local activism. Ultimately, this programme develops their aptitude towards environmental citizenship.

Conclusions

There is a growing need for ESD since it equips students with the knowledge, skills and values necessary to tackle the complex challenges of our time. The "Speak to Me in Numbers" programme demonstrates the potential of such ESD initiatives in fostering agency among students and promoting change through activism. By empowering students to become agents of change, these programmes have the potential to bring about significant positive impacts on local and global scales. Nevertheless, although teaching students about the severity of environmental issues is essential, an overwhelming emphasis on doom and gloom may inadvertently create anxiety or a sense of powerlessness. Therefore, a balanced approach that combines awareness with hope, empowerment and practical solutions should be adopted to ensure that ESD initiatives positively impact students' well-being and motivation to act (Kelsey & Armstrong, 2012; Kelsey, 2016; Kerret *et al.*, 2020). This is achieved in the "Speak to Me in Numbers" programme, for example, by careful wording of pedagogical content, focusing on tangible, real-world data evidence and fostering students' agency to act upon newly established knowledge to bring about a sustainable change in their world.

Future research could explore the long-term effects of ESD programmes that foster students' agency and environmental citizenship, such as the "Speak to Me in Numbers" programme, on students' attitudes, behaviours and engagement with sustainability issues. Investigating the efficacy of different teaching methodologies, the role of cultural contexts and the impact of collaborative learning approaches would provide valuable insights into optimising the effectiveness of such ESD initiatives. Additionally, studying the factors contributing to the successful implementation and scaling up of such ESD programmes can aid in developing guidelines and formulating the best practices for educators and policymakers.

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